	without u_A	$\varepsilon = 2.5$
$\left\Vert H_{e_0\Delta}(z) \right\Vert_\infty$	5.241	1.201
$\left\Vert e_0 \right\Vert_\infty$	8.521	0.69
G	-	$\begin{bmatrix} 0.313 & -1.421 \end{bmatrix}$

Table 2 shows the influence of additive u_A on performences control system, in effect, the error $e_0(k)$ is limited by the presence of u_A.

3.2 Application of the *F.D.I.M.C*

In this part, it is intended to apply the *I.M.C* in the regulation of nonlinear system considered. In order to apply the *I.M.C* is used to elaborate the inverse fuzzy model required in the synthesis of the regulator.The decomposition of the overall fuzzy system proposed has five fuzzy subsystems set of 5 basic meshes: $(1,1,1)$, $(2,1,1)$, $(3,1,1)$, $(4,1,1)$ and $(5,1,1)$.

Let $P1$ le vecteur composé des entrées $e_1 = y(k)$ et $e_2 = y(k+1)$. The fuzzy system's output is $s = y_f(k+2)$.

The output of the subsystem defined on the fuzzy elementary mesh (i_1, i_2, i_3) is given by the following expression:

$$s(i_1,i_2,i_3) = \sum\nolimits_{\nu 3 \in \{0,1\}} \Theta_{(i_1,i_2,i_3)}(i_3+\nu_3, P1).\mu_{A_3^{i_3}}(e_3) = \left(\sum\nolimits_{\nu 3 \in \{0,1\}} \left(\begin{array}{l} \sum\nolimits_{(\nu_1,\nu_2)\in\{0,1\}^2} \xi^{(i_1+\nu_1, i_2+\nu_2)}(P1). \\ \Theta(i_1+\nu_1, i_2+\nu_2, i_3+\nu_3) \end{array} \right) \right).\mu_{A_3^{i_3}}(e_3)$$
$$e_1 = y(k), e_2 = y(k+1) \text{ and } e_3 = u(k) \tag{43}$$

with:

$$\Theta_{(i_1,i_2,i_3)}(i_3+v_3, P1) = \sum\nolimits_{(v_1,v_2)\in} \xi^{(i_1+v_1, i_2+v_2)}(P1).\Theta(i_1+v_1, i_2+v_2, i_3+v_3)$$
$$v_3 \in \{0,1\} \tag{44}$$

From this transformation, for each elementary mesh, there are only two rules rather than 2^3.For example for the mesh $(3,1,1)$ of the output generated by appropriate fuzzy system can be expressed by the relation (45) as follows:

$$s_{(3,1,1)} = u(k)\begin{bmatrix} -0.024y(k)y(k+1) - 0.068y(k) - \\ 0.009y(k+1) - 0.097 \end{bmatrix}$$
$$+0.102y(k) + 0.013y(k+1) + 0.036y(k)y(k+1) + 0.145 \tag{45}$$

By use of the reversing mechanism fuzzy rules of the model are transformed into rules of order. To construct the inverse model (46), we must ensure that:

$$\frac{dy(k+2)}{du(k)} \neq 0 \tag{46}$$

3.3 Simulation results

Simulation results of the closed loop system are obtained by Fig. 6, 7, 9 and 10 following. For $\varepsilon = 2.5$ the Fig 7, and 8 show respectively the reference trajectory and the output of the system. We chose, first, as the model under fuzzy system whose entries belong to the mesh $(3,1,1)$, the response's system and the evolution of the drive are presented in Fig 28 and 29 following, then, is implanted under the five fuzzy systems developed the overall fuzzy system and we consider the minimal error between the output of the trial and the output nonlinear models *I.M.C* in the closed loop. The system output is now tainted by a disturbance equal to a unit step applied at time $t = 10s$. Simulations are performed if the model is the subsystem of the mesh and if we take into account all sub fuzzy systems of the overall system shown respectively in Fig 8, 11 and 33. The simulation results obtained by applying the two control techniques *I.O.F.D.L* and *F.D.I.M.C*, have emphasized the interest shown, no stability guarantee view for the controlled system. The application of the law control additive u_A, in the case of *I.O.F.D.L*, introduced improvements to the trajectory tracking system, by minimizing the error $e_0(k)$ between the system response and the desired output. However, due to external disturbances on the output, improving system performance is obtained by *F.D.I.M.C* while it is not guaranteed by the technique of *I.O.F.D.L* which required optimization H_∞.

4 Conclusion

We underlined the performance monitoring undertaken by the two methods of regulation adopted on the oscillatory system. However, the *I.O.F.D.L*, despite the satisfactory results presented point of view trajectory tracking, it cannot guarantee the performance maintains the controlled system such external disturbances. While the structure maintains *F.D.I.M.C* gave a satisfactory performance despite all the considered approximations and external disturbance on the output.

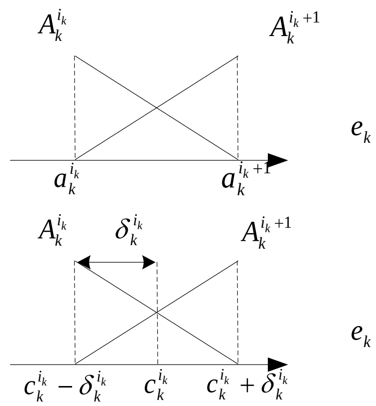

Fig.1 Parameterization of Fuzzy Symbols Inputs

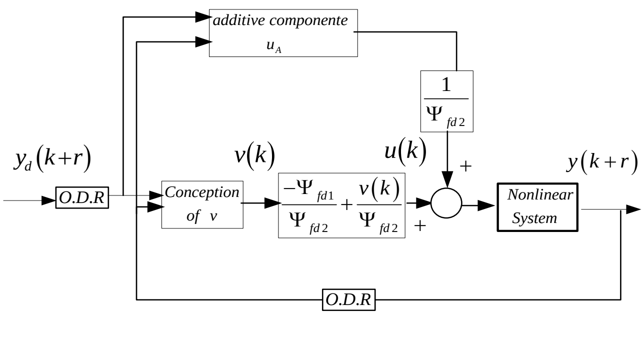

Fig.2 Robustification de la L.E.S.D.F

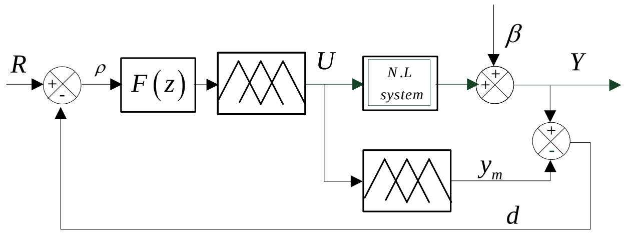

Fig.3 Structure of the Fuzzy Internal Model Control *F.I.M.C* for Nonlinear Systems

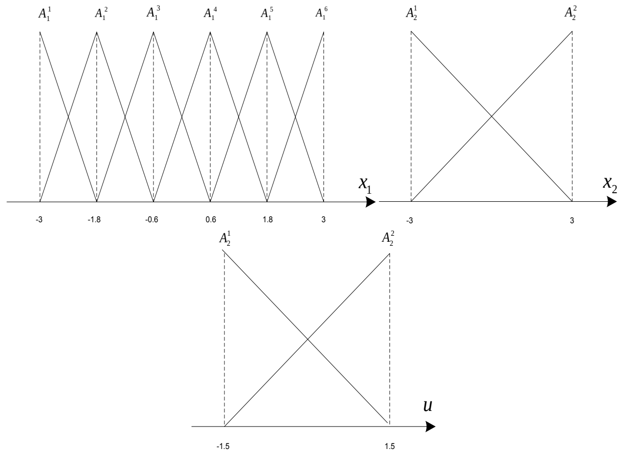

Fig.4 Fuzzy Partition of Universes of Discourse

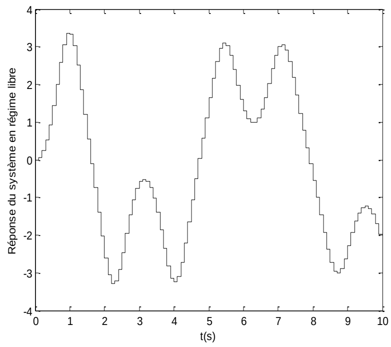

Fig.5. Response of the System in the Open Loop

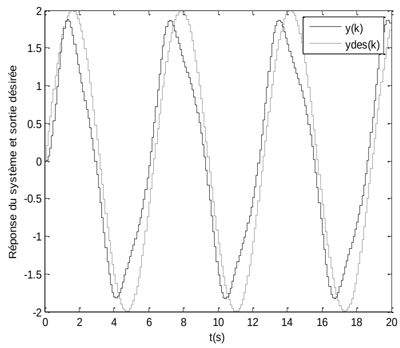

Fig.6. Reference Trajectory and Output of the Closed Loop System without uA

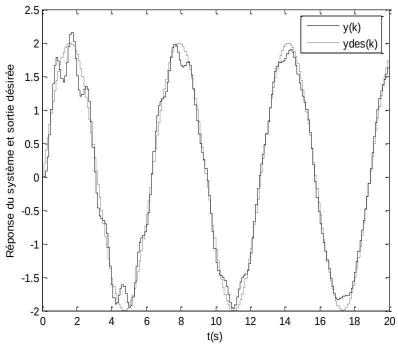

Fig.7. Reference Trajectory and Output of the System for $\varepsilon = 2.5$

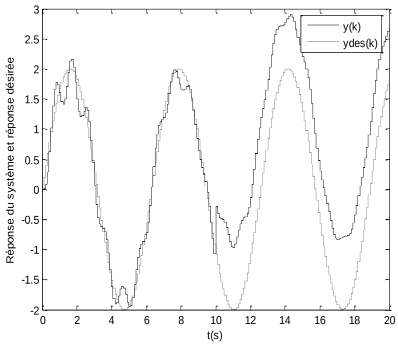

Fig.8. Reference Trajectory and Output of the System for $\varepsilon = 2.5$ in presence of disturbance

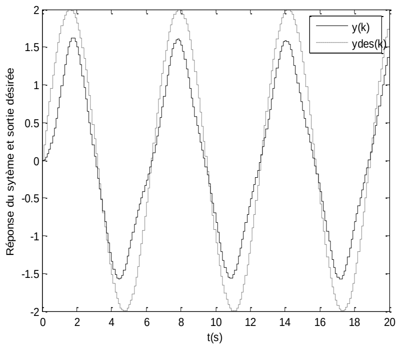

Fig.9 Reference Trajectory and the System's Output for the Mesh Subsystem $(3,1,1)$

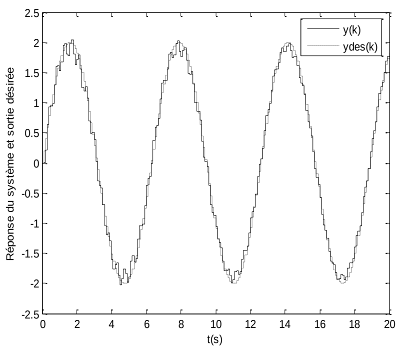

Fig.10. Reference Trajectory and the System's Output for all Fuzzy Subsystems

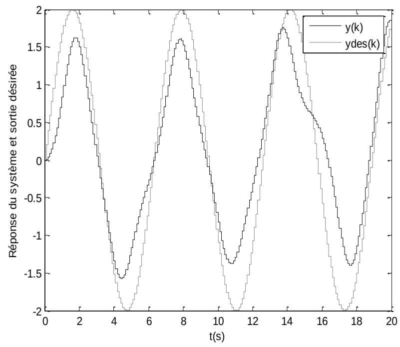

Fig.11. Reference Trajectory and the System's Output for the Mesh Subsystem $(3,1,1)$ in Presence of Disturbance

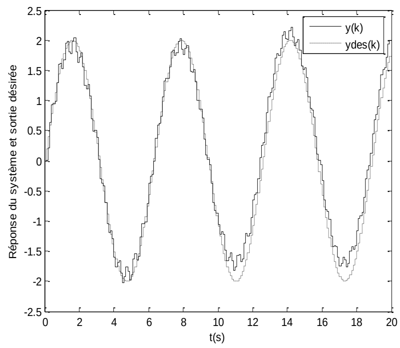

Fig.12. Reference Trajectory and System's Output for all Fuzzy Subsystems in Presence of Disturbance

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